MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

HIGH LEVEL ARCHITECTURE PERFORMANCE MEASUREMENT

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High Level Architecture (HLA) uses an implicit Runtime Infrastructure (RTI) that completely encapsulates all simulation systems. This implementation on a networked virtual environment might be limited and could affect the overall system performance. The performance of HLA on PC workstations in a networked virtual environment might not be determined, and therefore the effects and limitations of its implementation could severely hamper the realism of real-time virtual environments. The goal of this thesis is to determine the limitations of the HLA in a networked virtual environment on the Windows NT platform. In identifying the limitations of HLA, we will be able to ascertain the areas in which HLA can be improved. This thesis implements and measures the system performance of three different setups, namely a standalone virtual environment, a networked virtual environment using HLA, and a networked virtual environment using User Datagram Protocol (UDP). The system performance measured includes average CPU, network, graphics and memory processing requirements, frame rate per second, and the reliability of data received. The results indicate the use of heavily threaded processes by HLA significantly reduces overall system performance.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: High Level Architecture, User Datagram Protocol

COMPARISON OF VEGA™ AND JAVA3D™ IN A VIRTUAL ENVIRONMENT ENCLOSURE

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Large enclosures offer a myriad of possibilities for virtual environments and can dramatically improve presence for a number of applications. Scene graphs are accepted as the logical and optimized way to generate and render applications, however most scene graphs are proprietary or platform specific. Open source scene graphs are emerging that are easily used and cross-platform.

This thesis describes the physical construction of a large sized Multiple Angle Automatic Virtual Environment (MAAVE) and the programming of visual simulations using Vega, a powerful commercially

available software package, and Java3D, an open source scene graph. The two simulations are networked walkthrough virtual environments using the same geometry.

After the MAAVE was built, the two applications were tested on multiple platforms with frame rate being the main measure of performance. Initial expectations were that Vega would be faster, but the ease and speed of development of each application was unknown. Results showed that the Vega application was 10 to 30 times faster on sgi hardware and 4 to 20 times faster on a standard PC. The Java3D application required one third of the development time and was easier to program. Overall, we conclude that Vega is the better development platform for multi-channel walkthrough applications.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Virtual Environment, Visual Simulation, Scene Graph, Networking, CAVE, MAAVE

OBJECT SIGNING IN BAMBOO

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The rapid growth in the Internet has been fueled by an exorbitant number of users, organizations and individuals alike, many relying on e-commerce to conduct business including the transport of files. Public Key Infrastructure (PKI) technology has emerged to the forefront as the basis for ensuring secure transactions throughout the Internet. However, this technology is prohibitively expensive for the majority of users. Object signing technology, a subset of PKI technology, provides a veritable means for file transfer ensuring non-repudiation, authentication, and content integrity at an amenable cost.

This thesis provides an introduction to computer security with a specific focus on PKI and object signing technology. It details the selection and implementation of an object signing system layered on Bamboo, namely Pretty Good Privacy (PGP) v2.6.2. Procedures for establishing a Key Server for certificate distribution are also illustrated. It also introduces security pitfalls associated with PKI systems and identifies the security weaknesses of this object signing implementation. For further research, recommendations are provided to improve the overall functionality of this security system and the potential impact any such migration may have on current users.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Modeling and Simulation

KEYWORDS: Object Signing, Public Key Infrastructure, PKI, PGP